

VASCULAR PLANT SPECIES/AREA RELATIONSHIPS (SPECIES RICHNESS)
IN THE WEST GULF COASTAL PLAIN: A FIRST APPROXIMATION

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ABSTRACT

We surveyed the West Gulf Coastal Plain literature for information on vascular plant species/area relationships (species richness) and produced curves for small (micro-) areas (< 5 ha) and large (macro-) areas (> 50 ha). A brief preliminary comparison of species richness between the West Gulf Coastal Plain and the Atlantic and East Gulf Coastal Plain indicates that while some micro-scale areas may be richer in species in the East Gulf Coastal Plain, macro-scale areas have about the same richness in both areas.

RESUMEN

Se revisó la bibliografía sobre la llanura costera del West Gulf en busca de información sobre especies de plantas vasculares /relación con el área (riqueza de especies) y se hicieron curvas para micro-áreas (< 5 ha) y macro-áreas (> 50 ha). Una breve comparación preliminar de la riqueza de especies entre la llanura costera del West Gulf y la llanura costera del Golfo Atlántico y del Este indica que mientras algunas micro-áreas pueden ser mas ricas en especies en la llanura costera del East Gulf, las macro-áreas tienen aproximadamente la misma riqueza en ambas áreas.

INTRODUCTION

We have noted that many papers seeking to compare an area's species richness find few relevant studies with comparable information. For example, addressing the long-held belief that the Big Thicket is species rich, Diggs et al. (2006:169) ask: "How does [the Big Thicket] compare with other areas of similar size?" But, lacking "the needed comparative data," they were unable to answer the question. Being interested in species richness for some time and having collected considerable information on it for various communities and locations in the West Gulf Coastal Plain over the past two decades (MacRoberts & MacRoberts 1992b), we decided to survey the literature to see if we could locate enough data to draw a species/area curve for the West Gulf Coastal Plain.

Whittaker (1972) defined alpha, beta, and gamma diversity (richness). In this paper, we will be concerned with alpha diversity (within habitat or community, such as for a pitcher plant bog, prairie, or baygall) and gamma diversity (geographic scale diversity, such as for a county or state, which include many communities and habitats). We will not use Whittaker's terms in this paper but will speak only of species richness to cover both alpha and gamma diversity; all references to areas smaller than 5 ha in this paper indicate alpha diversity and all references to areas larger than 50 ha indicate gamma diversity.

METHODS/RESULTS

We surveyed the West Gulf Coastal Plain—eastern Texas, western Louisiana, southeastern Oklahoma, and southern Arkansas (Fig. 1)—literature for species richness information. Our criterion for accepting or rejecting a study was its thoroughness. This unfortunately left out most county/parish checklists done as Masters theses since few are thorough and virtually none are published. Nonetheless, we found data for both large and small areas including many community types (Peterson & Brown 1983; Matos & Rudolph 1985; MacRoberts & MacRoberts 1988, 1990, 1991, 1992a, 1992b, 1993a, 1993b, 1993c, 1994, 1995a, 1995b, 1996a, 1996b, 1997, 1998a, 1998b, 2001, 2003, 2004a, 2004b, 2004c, 2005, 2006, in prep.; MacRoberts

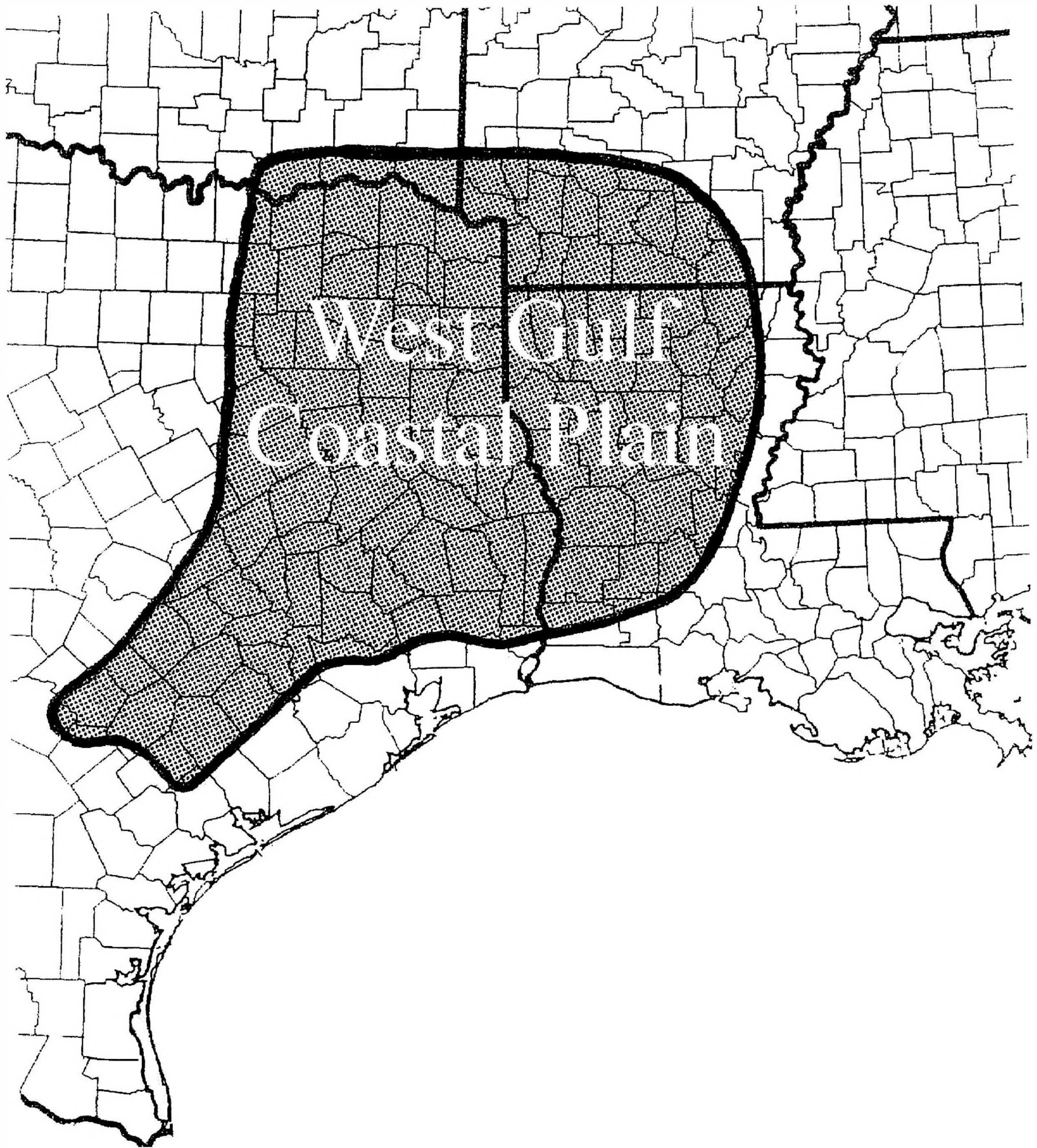


FIG. 1. Map showing extent of West Gulf Coastal Plain.

et al. 2002a, 2002b, 2002c, 2003, 2004; Thomas & Allen 1993–1998; Nesom & Brown 1998; Diggs et al. 1999, 2006; Neill 2000; Fleming et al. 2002; Neyland 2002; Singhurst et al. 2003; Brown et al. 2005, 2006; Philipps et al. in prep.; Thomas et al. in prep.) We plotted the data on a log/log scale. We did this separately for areas smaller than 5 ha and for areas larger than 50 ha. The results are shown in Figures 2 and 3.

DISCUSSION

There is wide variation in number of taxa reported for the same and for different sized areas in the West Gulf Coastal Plain. The reasons are many. Community differences account for some of the difference be-

West Gulf Coastal Plain Species Area Curve [Micro-areas = area < 5 ha]

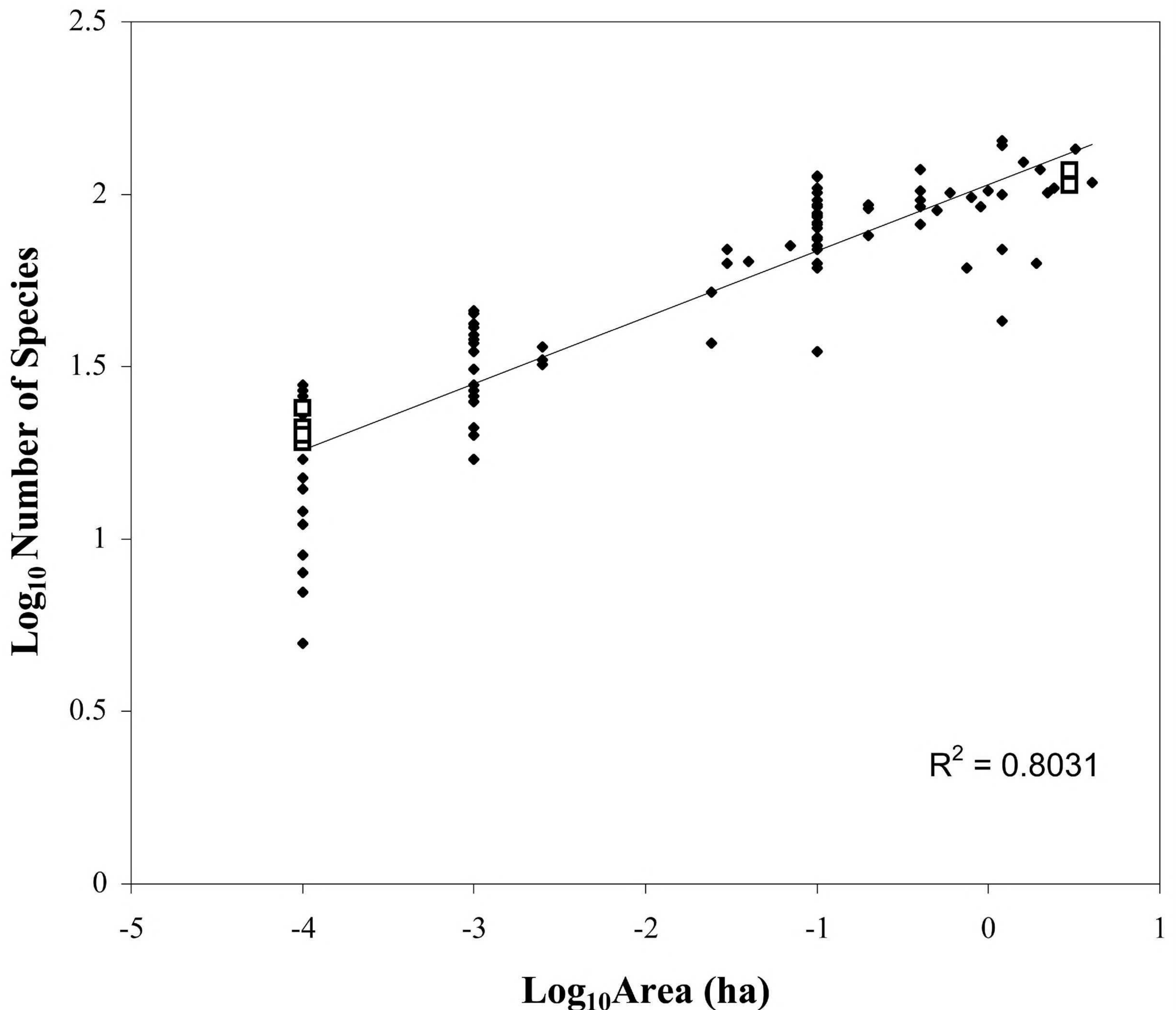


FIG. 2. West Gulf Coastal Plain species/area curve (Micro-areas = area < 5 ha). Open boxes are Big Thicket sites.

cause different communities have different species numbers. For example, baygalls have fewer species per unit area than pitcher plant bogs (MacRoberts & MacRoberts 2001; MacRoberts et al. 2004). Thoroughness of collecting differs considerably. Some areas have been collected extensively for years, while others have not. For example, while Caddo Parish has been the subject of three checklists, few counties/parishes in the West Gulf Coastal Plain, notably in Texas, have been the subject of one (MacRoberts & MacRoberts 2006). Taxonomic preferences also affect numbers. Some investigators report species, subspecies, and varieties while others report only species (MacRoberts & MacRoberts 2006). Finally, inclusion criteria differ. Some investigators collect extensively in urban parks and lawns, transportation routes, and other highly disturbed ruderal areas and report many more non-natives than do others.

Nonetheless, allowing for these sources of variation and potential error, Figures 2 and 3 allow for general comparisons. For example, the question posed by Diggs et al. (2006) in our introductory remarks is now answerable. According to Diggs et al. (2006) the Big Thicket consists of 17,974 sq km and has 1826

West Gulf Coastal Plain Species Area Curve [Macro-areas = area > 50 ha]

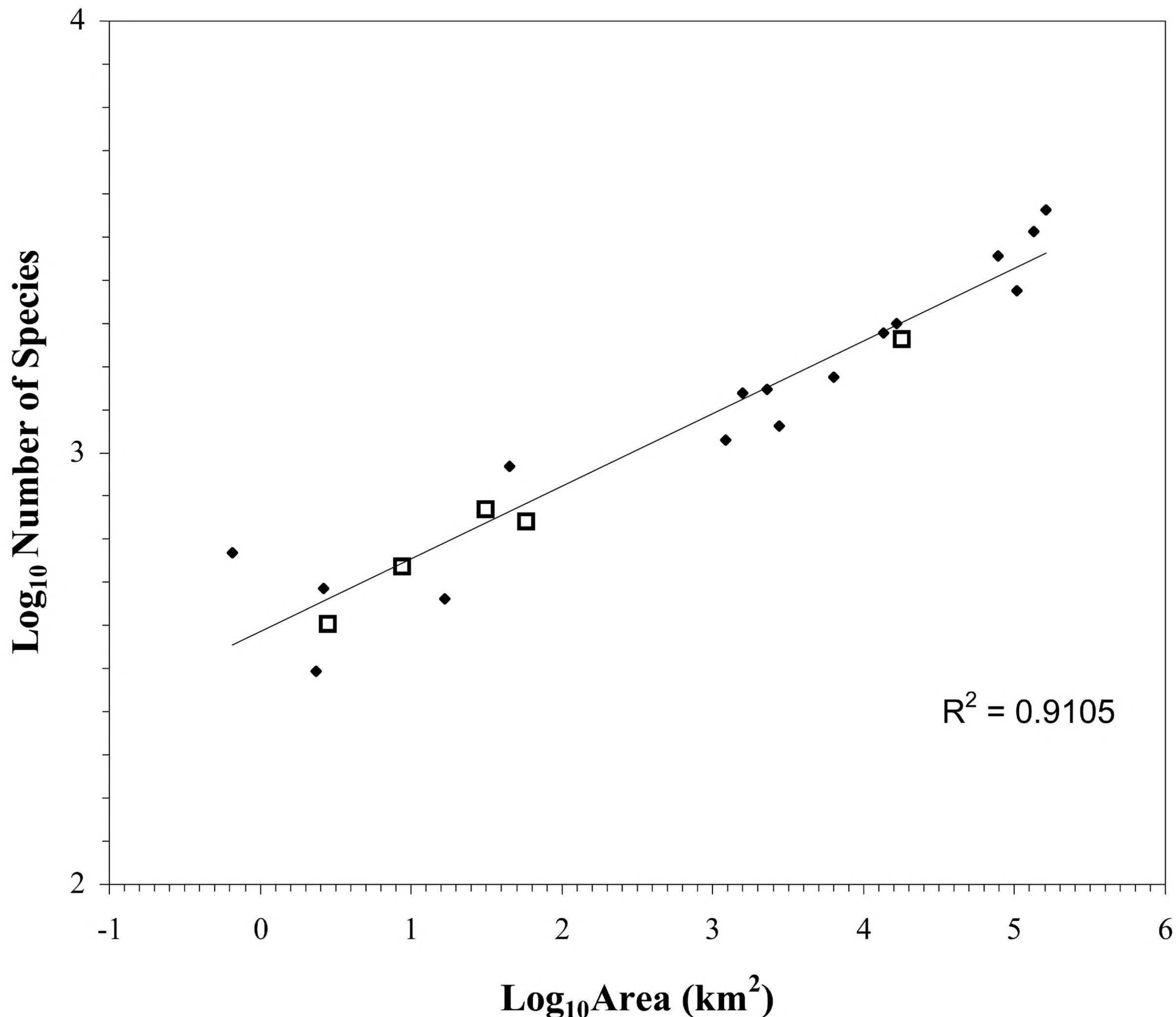


FIG. 3. West Gulf Coastal Plain species/area curve (Macro-areas = area > 50 ha). Open boxes are Big Thicket sites.

taxa. Located on the curve in Figure 3, the Big Thicket is therefore average. At micro-scale levels, although the data are scanty, the Big Thicket is typical: two 3.0 ha wetland pine savannas had 106 and 117 taxa, and four 0.0001 ha wetland pine savanna plots had 19, 20, 21, and 24 taxa (Fig. 2). At intermediate macro-scale levels: 2.84 sq km, 8.81 sq km, 31.5 sq km, and 58.1 sq km, the Big Thicket also appears to be unexceptional with 401, 544, 738, and 693 taxa respectively (Matos & Rudolph 1985; MacRoberts & MacRoberts 1998a; MacRoberts et al. 2002c; Brown et al. 2005, 2006)(Fig. 3).

While the aim of this paper is to develop species richness curves for the West Gulf Coastal Plain, it is almost impossible not to compare our figures with those farther east, since it has been suggested that the West Gulf Coastal Plain may not be as rich as the Atlantic and East Gulf Coastal Plain (Currie & Paquin 1987; Currie 1991). For example, Fort Bragg Military Reservation, North Carolina, consists of 738 sq. km and has an impressive 1206 taxa (Sorrie et al. 2006). Platt (1999) summarized some of the small area plots in frequently burned pine savannas in the Atlantic Coastal Plain: up to 30–40 species in 0.0001 ha plots,

70–90 species in 0.01 ha plots, and 100–150 species in 0.1 ha plots, making these the most species rich sites reported in North America (Walker & Peet 1983; Peet & Allard 1993; Brewer 1998).

However, state and county sized areas appear to be less spectacular: Florida, consisting of 170,305 sq km, has 3834 species of which 31% are exotics (Wunderlin 1998); the Florida panhandle, consisting of 38,628 sq km, has 2359 species of which 16% are exotics (Clewell 1985); Oktibbeh County, Mississippi, consisting of 1185 sq km, has 1148 species of which 15% are exotics (Leidolf et al. 2002); and Pike County, Alabama, consisting of 1759 sq km, has 1190 species of which 20% are exotics (Diamond 2003). Comparable areas in the West Gulf Coastal Plain appear to be as species rich. For example, east Texas, consisting of 162,134 sq km, has 3660 taxa (3402 species) of which 18% are exotic (Diggs et al. 2006); the Gus Engeling Wildlife Management Area in Anderson County, Texas, consisting of 45 sq km, has an impressive 930 taxa (Singhurst et al. 2003); the Walter B. Jacobs Memorial Nature Park, Caddo Parish, Louisiana, consisting of 65 ha, has a staggering 587 taxa (Thomas et al. in prep.); and Caddo Parish, Louisiana, consisting of 2,284 sq km, has an impressive 1405 species of which 17% are exotic (MacRoberts & MacRoberts 2006). At the micro-scale level, bogs, xeric sandylands, and upland longleaf pine savannas in the West Gulf Coastal Plain, while not reaching the higher numbers reported east of the Mississippi River, have been reported with up to 28 species in 0.0001 ha plots, 46 in 0.001 ha plots, and 113 in 0.1 ha plots (MacRoberts & MacRoberts 1993b, 2004c; MacRoberts et al. 2002b; Philipps et al. in prep).

These are preliminary comparisons. This paper is a first approximation at a West Gulf Coastal Plain species-area curve. It is based on a wide variety of sources, most of which were not prepared for the purpose of measuring species richness. Additionally, the data are relatively few. More information is needed on both micro- and macro-scale areas. Undoubtedly, further research, notably in frequently burned West Gulf Coastal Plain open habitats such as bogs, pine savannas, upland longleaf forest/savanna, xeric sandylands, and prairies, will alter these curves and make species-richness comparisons truly possible within the Gulf Coastal Plain and between the Gulf Coastal Plain and areas to the east, north, and west.

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REFERENCES

- BREWER, J.S. 1998. Patterns of plant species richness in a wet slash-pine (*Pinus elliotii*) savanna. *J. Torrey Bot. Society* 125:216–224.
- BROWN, L.E., B.R. MACROBERTS, M.H. MACROBERTS, P.A. HARCUMBE, W.W. PRUESS, I.S. ELSIK, and D. JOHNSON. 2005. Annotated checklist of the vascular flora of the Turkey Creek Unit of the Big Thicket National Preserve, Tyler and Hardin counties, Texas. *Sida* 21:1807–1827.
- BROWN, L.E., B.R. MACROBERTS, M.H. MACROBERTS, P.A. HARCUMBE, W.W. PRUESS, I.S. ELSIK, and S.D. JONES. 2006. Annotated checklist of the vascular flora of the Big Sandy Creek Unit, Big Thicket National Preserve, Texas. *Sida* 22: 705–723.
- CLEWELL, A.F. 1985. Guide to the vascular plants of the Florida panhandle. Univ. Presses of Florida, Florida State Univ. Press, Tallahassee.
- CURRIE, D.J. 1991. Energy and large-scale patterns of animal- and plant-species riches. *Amer. Naturalist* 137: 27–49.
- CURRIE, D.J. and V. PAQUIN. 1987. Large-scale biogeographical patterns of species richness of trees. *Nature* 329:326–327.
- DIAMOND, A.R. 2003. A checklist of the vascular flora of Pike County, Alabama. *Castanea* 68:143–159.
- DIGGS, G.M., B.L. LIPSCOMB, and R.J. O'KENNON. 1999. Shinnery & Mahler's illustrated flora of north central Texas. *Sida, Bot. Misc.* 16:1–1626.
- DIGGS, G.M., B.L. LIPSCOMB, M.D. REED, and R.J. O'KENNON. 2006. Illustrated flora of east Texas. *Sida, Bot. Misc.* 26: 1–1594.

- FLEMING, K.M., J.R. SINGHURST, and W.C. HOLMES. 2002. Vascular flora of Big Lake Bottom Wildlife Management Area, Anderson County, Texas. *Sida* 20:355–371.
- LEIDOLF, A., S. MCDANIEL, and T. NUTTLE. 2002. The flora of Oktibbeha County, Mississippi. *Sida* 20:691–765.
- MACROBERTS, B.R. and M.H. MACROBERTS. 1988. Floristic composition of two west Louisiana pitcher plant bogs. *Phytologia* 65:184–190.
- MACROBERTS, B.R. and M.H. MACROBERTS. 1990. Vascular flora of two west Louisiana pitcher plant bogs. *Phytologia* 68:271–275.
- MACROBERTS, B.R. and M.H. MACROBERTS. 1991. Floristics of three bogs in western Louisiana. *Phytologia* 70:135–141.
- MACROBERTS, M.H. and B.R. MACROBERTS. 1992a. Floristics of a sandstone glade in western Louisiana. *Phytologia* 72:130–138.
- MACROBERTS, B.R. and M.H. MACROBERTS. 1992b. Floristics of four small bogs in western Louisiana with observations on species/area relationships. *Phytologia* 73:49–56.
- MACROBERTS, B.R. and M.H. MACROBERTS. 1993a. Floristics of two Louisiana sandstone glades. *Phytologia* 74:431–437.
- MACROBERTS, B.R. and M.H. MACROBERTS. 1993b. Floristics of a bog in Vernon Parish, Louisiana, with comments on noteworthy plants in western Louisiana. *Phytologia* 75:247–258.
- MACROBERTS, M.H. and B.R. MACROBERTS. 1993c. Vascular flora of sandstone outcrop communities in western Louisiana, with notes of rare and noteworthy species. *Phytologia* 75:463–480.
- MACROBERTS, M.H. and B.R. MACROBERTS. 1994. Floristics of a xeric sandyland in western Louisiana. *Phytologia* 77:414–424.
- MACROBERTS, B.R. and M.H. MACROBERTS. 1995a. Vascular flora of two calcareous prairie remnants on the Kisatchie National Forest, Louisiana. *Phytologia* 78:18–27.
- MACROBERTS, B.R. and M.H. MACROBERTS. 1995b. Floristics of xeric sandhills in northwestern Louisiana. *Phytologia* 79:123–131.
- MACROBERTS, B.R. and M.H. MACROBERTS. 1996a. Floristics of xeric sandhills in eastern Texas. *Phytologia* 80:1–7.
- MACROBERTS, B.R. and M.H. MACROBERTS. 1996b. The floristics of calcareous prairies on the Kisatchie National Forest, Louisiana. *Phytologia* 81:35–43.
- MACROBERTS, B.R. and M.H. MACROBERTS. 1997. Floristics of beech-hardwood forest in east Texas. *Phytologia* 82:20–29.
- MACROBERTS, B.R. and M.H. MACROBERTS. 1998a. Floristics of wetland pine savannas in the Big Thicket National Preserve, southeast Texas. *Phytologia* 85:40–50.
- MACROBERTS, B.R. and M.H. MACROBERTS. 1998b. Floristics of muck bogs in east central Texas. *Phytologia* 85:61–73.
- MACROBERTS, B.R. and M.H. MACROBERTS. 2001. Bog communities of the West Gulf Coastal Plain: a profile. *Bog Res. Pap. Bot. Ecology* 1:1–151.
- MACROBERTS, M.H. and B.R. MACROBERTS. 2003. The east-west transition of flora in Texas: a biogeographical analysis. *Sida* 20:1693–1700.
- MACROBERTS, M.H. and B.R. MACROBERTS. 2004a. The Big Thicket: typical or atypical? *East Texas Hist. J.* 42:42–51.
- MACROBERTS, M.H. and B.R. MACROBERTS. 2004b. Understory composition in shortleaf/loblolly oak/hickory landscapes. Unpublished report. Kisatchie National Forest, Louisiana.
- MACROBERTS, B.R. and M.H. MACROBERTS. 2004c. Floristics of upland longleaf pine savanna in central Louisiana. *Proc. Louisiana Acad. Sci.* 65:1–13.
- MACROBERTS, M.H. and B.R. MACROBERTS. 2005. The ecology of *Trillium texanum* (Trilliaceae) on the Angelina National Forest, Texas. *Sida* 21:1893–1903.
- MACROBERTS, M.H. and B.R. MACROBERTS. In Prep. Vascular flora and community structure of the C. Bickham-Dickson Park/Red River Education and Research Park, Caddo Parish, Louisiana, Red River floodplain. 25 page ms.

- MACROBERTS, B.R. and M.H. MACROBERTS. 2006. An updated, annotated vascular flora of Caddo Parish, Louisiana, with notes on regional phytogeography and ecology. *Sida* 22:1191–1219.
- MACROBERTS, B.R., M.H. MACROBERTS, and L.S. JACKSON. 2002a. Floristics and management of pitcher plant bogs in northern Natchitoches and Winn Parishes, Louisiana. *Proc. Louisiana Acad. Sci.* 64:14–21.
- MACROBERTS, B.R., M.H. MACROBERTS, and J.C. CATHEY. 2002b. Floristics of xeric sandylands in the post oak savanna region of east Texas. *Sida* 20:373–386.
- MACROBERTS, B.R., M.H. MACROBERTS, and L.E. BROWN. 2002c. Annotated checklist of the vascular flora of the Hickory Creek Unit of the Big Thicket National Preserve, Tyler County, Texas. *Sida* 20:781–795.
- MACROBERTS, M.H., B.R. MACROBERTS, and L.S. JACKSON. 2003. Louisiana prairies. Pp. 80–93. In E. Peacock and T. Schauwecker (eds.) *Blackland prairies of the Gulf Coastal Plain*. Univ. Alabama Press, Tuscaloosa.
- MACROBERTS, B.R., M.H. MACROBERTS, and L.S. JACKSON. 2004. Floristics of baygalls in central Louisiana. *Phytologia* 86:1–22.
- MATOS, J.A. and D.C. RUDOLPH. 1985. The vegetation of the Roy E. Larsen Sandylands Sanctuary in the Big Thicket of Texas. *Castanea* 50:228–249.
- NEILL, A.K. 2000. The vascular flora of Madison County, Texas. MS Thesis, Texas A & M University. College Station.
- NESOM, G.L. and L.E. BROWN. 1998. Annotated checklist of the vascular plants of Walker, Montgomery, and San Jacinto counties, east Texas. *Phytologia* 84:107–153.
- NEYLAND, R. 2002. An update to the vascular flora of Calcasieu Parish, Louisiana. *Sida* 20:431–433.
- PEET, R.K. and D.J. ALLARD. 1993. Longleaf pine vegetation of the southern Atlantic and eastern gulf coastal regions: a preliminary classification. *Proc. Tall Timbers Fire Ecol. Conf.* 18:45–80.
- PETERSON, C.D. and L.E. BROWN. 1983. *Vascular flora of the Little Thicket Nature Sanctuary, San Jacinto County, Texas*. Brunswick Press, Houston.
- PHILIPPS, T., S.B. WALKER, B.R. MACROBERTS, and M.H. MACROBERTS. In Prep. Fox Hunter's Hill floristic survey.
- PLATT, W.J. 1999. Southeastern pine savannas. In: R.C. Anderson, J.S. Fralish, and J.M. Baskin, eds. *Savannas, barrens and rock outcrop plant communities of North America*. Cambridge Univ. Press., Cambridge. Pp. 23–51.
- SINGHURST, J.R., J. CATHEY, D. PROCHASKA, H. HAUCKE, G.C. KROH, and W.C. HOLMES. 2003. Vascular flora of Gus Engeling Wildlife Management Area, Anderson County, Texas. *Southeastern Naturalist* 2:347–368.
- SORRIE, B.A., J.B. GRAY, and P.J. CRUTCHFIELD. 2006. The vascular flora of the longleaf pine ecosystem of Fort Bragg and Weymouth Woods, North Carolina. *Castanea* 71:129–161.
- THOMAS, R.D. and C.M. ALLEN. 1993–1998. *Atlas of the vascular flora of Louisiana*. 3 vols. Louisiana Department of Wildlife and Fisheries and The Nature Conservancy. Baton Rouge.
- THOMAS, R.D., L. RAYMOND, B.R. MACROBERTS, and M.H. MACROBERTS. In Prep. Documented and annotated checklist of the vascular flora of the Walter B. Jacobs Memorial Nature Park, Caddo Parish, Louisiana. *Proc. Louisiana Acad. Sci.* 27 page ms.
- WALKER, J. and R.K. PEET. 1983. Composition and species diversity of pine-wiregrass savannas of the Green Swamp, North Carolina. *Vegetatio* 55:163–179.
- WHITTAKER, R.H. 1972. Evolution and measurement of species diversity. *Taxon* 21:213–251.
- WUNDERLIN, R.P. 1998. *Guide to the vascular plants of Florida*. Univ. Presses of Florida, Tallahassee.